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AMPHIBIOUS SHIPS AND LANDING CRAFT PAST, PRESENT AND FUTURE

BY

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USAWC MILITARY STUDIES PROGRAM PAPER

AMPHIBIOUS SHIPS AND LANDING CRAFT
PAST, PRESENT, AND FUTURE

An Individual Essay

by

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Carlisle Barracks, Pennsylvania 17013
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Throughout recorded history many nations have incorporated the use of amphibious warfare in support of their strategic interests and objectives. Since this is true of the United States today and is likely to continue into the foreseeable future, this unique type of warfare deserves careful study and development by senior military leaders. This essay looks at one aspect of the complex art of amphibious warfare, the evolution of amphibious vessels. It examines the changes in amphibious ships and landing craft from the invasion of Britain by Julius Caesar in 55-56 B.C. to the present. It highlights significant events and technological advances which affected this evolution up through World War II and Korea. After providing an overview of the capabilities of present day US Navy amphibious vessels, a projection of the major characteristics of amphibious craft of the early years of the twenty-first century is made. The essay concludes with a brief discussion of the flexibility and capabilities the future amphibious commander will have at his disposal and the need to begin now to develop doctrine for their employment in support of US national interests.

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INTRODUCTION

History provides us with many examples of countries using amphibious warfare in conjunction with other forms of power to achieve certain national objectives. This has been true for the United States since 1776 when a party of Marines landed at Nassau in the Bahamas to obtain much needed supplies and weapons for General Washington's army, and will likely continue to be the case in the future. It is important that this often neglected form of warfare receive greater study and emphasis by military leaders now so they are ready to use it to full advantage when it is needed in the future. This article takes one small step in that direction by examining the evolution and employment of amphibious ships and landing craft past, present, and future.

World War II saw the massive use of amphibious warfare in both the European and Pacific theaters of operation. While the art of amphibious warfare was perfected during these operations, military leaders have been conducting amphibious warfare for at least thirty-five centuries. The evolution of this type of warfare has seen little change in the basic concept of the operation during this entire period. It is an operation in which the attacker commences on water and moves ashore against an enemy, usually "dug in," in a defensive position close to the shoreline.¹ Although a simple concept, amphibious operations are often described as the most difficult and complex of all military operations. While the basic concept has remained constant, the centuries have witnessed remarkable changes in the equipment, techniques, ships and landing craft associated with amphibious operations. This essay focuses on the changes in the characteristics of the

ships and landing craft used to support amphibious warfare. This will be done by examining the evolution of both amphibious ships and landing craft as they were modified to accommodate changes in amphibious support equipment and weapons technology. It will then look at how developing technology in the area of landing craft and ships will influence the amphibious operations in the early part of the twenty-first century.

Although the very need for the United States to maintain an amphibious assault capability is still raised periodically, recent history has reinforced the importance of this capability to our Nation's interests. In the words of Admiral Isaac C. Kidd, Jr.:

Recent events show that there is still a real need for a credible amphibious assault capability. Two of the clearest examples are the Falklands campaign and the operation in Grenada. There are many places and plausible scenarios where the landing of a force on a hostile shore is required. We are the world's experts in this most complicated of all military operations. Given our treaty commitments and the wide area of our national interests, this warfare specialty needs the attention of all of us.²

CAESAR'S INVASION OF BRITAIN

Although the art of amphibious warfare was being practiced for some thirty-five centuries prior to World War II, there had been very few changes made in the ships used to wage amphibious operations during this entire period. The first "Great General" to realize that this special type of warfare called for special types of ships and landing craft was probably Julius Caesar. His accounts of his invasions of Britain in 55 and 54 B.C. provide us with a record of the painful way he learned this lesson on his

first attempt in 55 B.C. and the modifications he made to his "assault vessels" for his successful invasion in 54 B.C.

In the summer of 55 B.C. Caesar assembled his ships for the invasion. They consisted of mercantile vessels to transport infantrymen, his cavalry and the heavy war machines of the day (i.e., catapults and rams). His shock troops were to be ferried across the channel in his fast war vessels. The mercantile transport ships were ill-suited for the landing conditions Caesar was to encounter on the coast of Britain. The vessels had high freeboards and relatively deep drafts. Propelled by massive square sails or a long bank of oars, they lacked maneuverability in tight quarters and effective means of disembarking troops. His invasion force of some eighty transport ships and some 10,000 men arrived off the coast at daylight and prepared to "land the assault force." Because of their size and deep draft, the transport ships could not get in close to the beach. Many of the Roman soldiers drowned as they attempted to get ashore. Burdened with armor and heavy weapons, those that did not drown were attacked by the Britons as they floundered in the surf. The Britons, clad only in light animal skins were able to move around in the water with ease striking the Romans at will. Unable to form into their customary ranks and follow their normal tactics the Roman soldiers were totally confused. As more ships moved in to off-load troops, the confusion only increased as they could not disembark with any degree of order.

In all of this mayhem, Caesar's only saving grace was the skillful employment of his shallower draft war galleys carrying his "shock troops" and smaller war machines (gunfire support). These vessels were able to get

in close enough on the flanks of the Britons to drive them back. The Romans, after receiving a great number of casualties, finally were able to push ashore and establish a beachhead. However, they were unable to move inland because the Roman cavalry had not yet arrived. The eighteen ships transporting the cavalry arrived off the coast four days later only to encounter a storm which sent half the ships back to the continent immediately. The other half headed for sheltered waters along the British coast only to be hit by another storm which sent them retreating to the continent. The situation for the Romans was not good; they had no cavalry to continue the invasion, winter was coming on, many of their ships were damaged and they were short on supplies. As soon as Caesar had enough ships repaired, he moved his forces back across the English Channel to "winter over" on the continent and regroup.

Caesar immediately began to plan for another invasion of Briton. During the winter of 55-54 B.C. he built a fleet of 800 "amphibious warfare" vessels. They were designed specifically to move and land troops and war engines. They were constructed with a low freeboard to facilitate easy disembarkation of troops and equipment. They were lighter, with a broader beam and a shallower draft than his earlier transports to permit ready access to the shoreline.

On 6 July 54 B.C. Caesar's amphibious force again arrived off the coast of Britain. This time he landed simultaneously on several beaches and met little resistance. His new assault vessels worked splendidly. Their shallow draft allowed them to proceed in close enough to the shore to permit the easy landing of men and equipment. His infantry landed in a disciplined, orderly formation and quickly established a beachhead. He then offloaded his cavalry and war machines prior to moving inland. At this point Caesar shifted roles

from that of the "Amphibious Task Force Commander" to that of "Land Force Commander" and completed a successful invasion of Britain.

In addition to recognizing the requirement for assault vessels specially designed for amphibious warfare, Caesar also "must be credited with realizing the necessity for special weapons, landing craft, a study of waters and tides fronting his proposed beachhead and special training of his troops. He encountered all the obstacles and forms of natural and man-made opposition, but what is more important, had the ability to put his experiences on paper for future generals to read and consider."³

WORLD WAR I

Between the time of Caesar's invasion of Britain and the twentieth century there were numerous amphibious landings conducted by various nations around the world. While the weapons and tactics used in these campaigns evolved over the years, the vessels used to conduct them changed very little. While the troop transports saw an evolution from wood to steel construction and steam or diesel engines replaced sails, the assault force was still sent ashore in boats similar to those used by Caesar. Probably the most significant improvements made were in the area of naval gunfire support for the landing forces. While still performing the same basic mission as Caesar's stone throwing catapults, the warships of the early 1900s equipped with "long ranged" guns were capable of causing tremendous destruction ashore.

In the early years of this century technological improvements in warfare tended to strengthen the defender more than the landing force. Some believed that offshore mines, torpedoes and land-based weapons would preclude the use

of naval gunfire support to cover an amphibious assault force trying to get ashore. The British disaster at Gallipoli confirmed in the minds of many that crossing a heavily defended beach was no longer possible. This belief was to foster the comment by Liddell Hart in 1939 that amphibious landings were now "almost impossible."⁴ This was of course not the last time history was to predict the end of amphibious warfare.

The Battle of Gallipoli provides us with a splendid example of how not to conduct an amphibious campaign, but more importantly to the theme of this essay, it provides us with the first examples of significant changes in amphibious assault craft in nearly 2,000 years.

In 1915 Axis and Allied forces were locked in place in the trenches of Europe. In an attempt to break this stalemate the Allies decided to invade Turkey and open a second front to relieve the pressure on the Allies in France. Additionally, they hoped to eventually defeat the Russian forces by attacking via Turkey. The operation began on 25 April 1915 and after heavy fighting and tremendous casualties the Allies finally secured a number of beachheads. However, after eight months they had only moved inland three miles. The invasion was called off and the troops were evacuated. By the time of the evacuation over half of the men in the six original divisions used in the invasion had been killed, wounded or captured.⁵

The fiasco at Gallipoli provided future amphibious planners with numerous lessons on how not to conduct an amphibious assault. However, it also saw the experimental use of the first attack transport, the RIVER CLYDE. The RIVER CLYDE was an old collier modified to carry assault troops in close to the beach. Doors had been cut into her sides to provide access to barges leading

to the beach. The plan called for the RIVER CLYDE to run up near the shore, the barges were then brought alongside the access doors providing gangways over which the troops were to race ashore. Due to heavy enemy rifle fire, almost none of the men who attempted to go ashore made it alive. While the employment of the RIVER CLYDE at Gallipoli was a failure, the concept proved to be useful and led to the development of the "work horse" of the amphibious Navy in World War II, the Landing Ship Tank (LST).⁶

In August, the Allies conducted an amphibious landing of reinforcements at Gallipoli. This landing saw the first use of the British developed "beetle boats" to carry troops ashore. The craft looked like a large barge, it was armored, motor-powered and could travel at speeds up to 5 knots. It was capable of carrying 500 men and was equipped with a swinging platform projected from the bow, which when lowered formed a broad ramp to the shore when beached.⁷ Despite these valuable innovations to the later development of amphibious vessels, they were not the most important lessons of the Gallipoli campaign. The history of Gallipoli with all its "faults, failures and follies" provides the amphibious planner with a "pattern of how not to attempt any such operation in the future."⁸

VESSELS OF WORLD WAR II

The years between World War I and World War II produced major changes in the construction of amphibious assault craft and ships. Many of the ideas for improvements in amphibious vessels originated in Britain; however, the United States also played an important role in developing new ships and landing craft used in the amphibious landings of World War II. Several types of

landing craft which were to prove invaluable during this war were modifications of craft developed for civilian applications.

In the mid-twenties an industrial pioneer from Louisiana named Andrew J. Higgins developed a shallow draft vessel designed for use in the bayous of Louisiana. The vessel's ability to beach and retract easily, its protected propeller, and small turning circle made it very suitable as a landing craft. From 1934 to 1941, these craft were used in the United States Marine Corps exercises and proved superior to other boats tested. The only problem was the lack of an easy way to disembark troops. They had to climb over the sides which proved rather clumsy. The Higgins boats were later modified by changing the bow to a ramp that could be lowered as soon as it was beached, this allowed troops to be debarked quickly. This design change also provided the Higgins boat with the ability to transport trucks and small tanks to the beach. The Higgins boats were the forerunners of the Landing Craft, Vehicle and Personnel (LCVP) and the larger Landing Craft Mechanized (LCM) and Landing Craft Utility (LCU), used by US forces throughout World War II.

Another vital World War II craft developed just prior to the war was the tracked landing vehicle (LVT) or amphibian tractor. The LVT, which was used extensively in the Pacific Island campaigns, was the "brain child" of Donald Roebling. The craft was originally designed as an amphibian tractor devised to perform rescue work in the Florida everglades. These Roebling "Alligators" were modified to carry troops and cargo ashore into combat. The troop version was designed to be launched via a stern gate or bow ramp from a larger ship and proceed ashore under its own power, like a boat. Once ashore it moved over land on tank-like tracks. It could carry about 30 men

ashore, where they would disembark through a rear ramp and engage the enemy. Another version, the LVTA, was equipped with additional armor and machine guns.⁹

World War II also saw the modification and improvement of some types of amphibious ships and the introduction of totally new designs. Of this, the LST, which as noted earlier can trace its heritage to the ill-fated RIVER CLYDE used at Gallipoli, was to become probably the most famous. The LST was designed to beach and land tanks to support assault troops as they went ashore. Throughout the war the LST would be used occasionally to land troops and equipment directly on to the shore where the hydrographic conditions permitted this. However, as amphibious planners were to learn, only a small percentage of the world's coastlines have beaches suitable for beaching LSTs. The LST proved to be an ideal ship for transporting LVTs and DUKWs (a wheeled amphibious tractor used to transport cargo) to the amphibious assault area and disembarking them into the water through the huge bow doors. The LST was to become primarily an assault transport in the Pacific war. The first wave of the troops would be loaded into their landing craft while they were still aboard the LST. The LST would then proceed to the vicinity of the hostile beach ready to deliver into the water their "litters" of amphibious vehicles loaded with troops and artillery. Additionally, some of these flexible ships were modified to serve as repair ships, offshore radar stations, and hospital wards.¹⁰

Another versatile amphibious ship to be introduced in the early 1940s was the Landing Ship Dock (LSD). This ship was to prove the forerunner to a long line of amphibious vessels with a floodable well deck. This ingenious

ship is equipped with numerous large ballast tanks throughout its structure. When water is pumped into these tanks and the stern gate is lowered the well deck can be flooded to permit landing craft already loaded with tanks, artillery or other vehicles required ashore, to float into it. As the water is pumped out of the ballast tanks, the craft settles down on to the floor of the well deck. Once the craft is secured in place and the stern gate closed, the LSD is now ready to transport the landing craft to the assault area. Using its well deck the LSD can embark and disembark all types of landing craft (up to the large LCU), amphibious cargo carriers and LVTs. Equipped with huge cranes, it is able to load and carry all types of wheeled vehicles on its main deck. Once the beach is secured these vehicles are loaded into landing craft or floating causeways sections to be moved ashore. The modern day LSD is also equipped with a flight deck for landing helicopters which add to the remarkable versatility of this ship.

Another craft, originally of British design used extensively in World War II was the Infantry Landing Craft (LCI). The LCI was equipped with ramps on either side of the bow for the rapid landing of troops directly on to the beach. While the LCI proved useful in Europe, the presence of reefs throughout the Central Pacific prevented its widespread use as designed in this theater. Many of these vessels were modified to serve as gunboats, rocket boats and mortar boats. In the Pacific, it became routine for these modified LCIs to "precede the first wave of troops close to shore to deliver a last-minute area bombardment."¹¹ The history of World War II clearly demonstrates the critical role amphibious warfare played in the outcome of the war in both Europe and the Pacific. It also provides us with a record of more developments and

improvements in the area of amphibious craft than at any other time in history. Eventually, during the war the US Navy alone built about 2,800 amphibious ships and independent landing craft capable of transoceanic crossings.¹²

POST WORLD WAR II TO THE MID 1980S

The dramatic end of the war in the Pacific with the dropping of atomic bombs again led some military leaders to announce that amphibious warfare was dead. It was "obvious" they argued, that a few atomic bombs would annihilate ships concentrated for a large scale World War II style landing, thereby negating the need for a US amphibious capability.¹³

In October of 1949 General Omar N. Bradley was to state, "I also predict that large scale amphibious operations will never occur again." While General Bradley's prediction carried the credibility of his position as the Chairman of the Joint Chiefs of Staff and the fact he had played major roles in the great amphibious assaults at Sicily and Normandy, his prediction would prove wrong in less than one year! In September of 1950, General Douglas MacArthur conducted a major amphibious landing at the port of Inchon, Korea. The "American Caesar" fully understood the operational value of the amphibious assault, having perfected its employment in his Pacific Island campaigns of the recently completed war. He knew that an amphibious assault in the enemy's rear would permit the opportunity for victory that a frontal attack could not.¹⁴ Despite the tremendous tidal range and mud flats that had to be contended with at Inchon, remarkable planning and execution by a combined Navy, Marine and Army team caused the Inchon landing to be a resounding success. This event undoubtedly turned the tide of the war in the favor of the United Nations' forces.

The Korean War saw the first widespread employment of the helicopter in support of battle. While the US Navy and Marines began to experiment with using a ship borne helicopter in the late 1940s, the Korean War "came before there were any suitable aircraft, tactics, or techniques" for their employment. Following the Korean War, the introduction of the helicopter as a "landing craft" and the concept of the vertical assault led to entirely new classes of amphibious assault ships and major modifications to others. Helicopters made it feasible to land assault forces at places once impregnable to amphibious assault. Additionally, the ships supporting the attack could be underway and widely dispersed during the assault.

In order to transport helicopters to the assault area, a carrier-like ship was required. At first an escort carrier from World War II was tried but proved to be too small. Although the fast Essex class carriers of the same era were really larger than was required, these were better suited for the mission than the small escort carrier. Three such carriers were used as amphibious assault ships pending the arrival of vessels specifically designed for the role. Seven of these ships, the Iwo Jima class Landing Platform Helicopter (LPH), came into service between 1961 and 1970, and the Essex class carriers departed.¹⁵ The marriage of helicopter and amphibious ship also contributed to the development of other amphibious vessels in the 1980s. However, before we look at these modern ships, there are some other earlier vessels which should be discussed.

A major amphibious landing has been described as one of the most complicated warfare operations. Anyone who has witnessed or has seen photos of the Normandy landing of World War II, which involved over 4,100 ships and landing

craft, would have little trouble agreeing with the assessment. It was realized that a special amphibious headquarters ship was required to plan and supervise the amphibious assault. It was unfortunate that General Patton did not have such a ship available in World War II for his landing at Casablanca. He had set up his command headquarters offshore in a US Navy cruiser, the Augusta, rather than one of the less "glamorous" amphibious ships. Shortly after the landing commenced the Augusta received immediate orders to depart the area. General Patton had no choice but to leave his army behind and go along for the ride. It was three days later before he and his headquarters staff were able to link up with his army.

The original headquarters ship was the AGC. This amphibious force flagship served as the hub of the force and originated all orders during an amphibious assault. Stationed on board would be the Commander Amphibious Task Force, Amphibious Movement and Attack Group Commanders and the Commander Amphibious Landing Force.¹⁶ These ships have been replaced with the amphibious command ships (LCC), which are a marvel of modern communication. Both ships of this class now serve as flagships.¹⁷

Another amphibious ship developed in World War II and further refined afterwards was the attack transport (APA). It carried and landed troops, supplies, and equipment. Each APA carried 22 organic landing craft and also embarked landing craft with men and material from other ships. Similar to the APA was the attack cargo ship AKA. It transported assault equipment, personnel, ammunition and supplies to the assault areas and then transferred them ashore by means of embarked landing craft.¹⁸ The follow-on to these ships were the amphibious cargo ship (LKA) and amphibious transport dock ship (LPD).¹⁹

As noted earlier, the introduction of the helicopter as a landing craft played a pivotal role in the development of the current US amphibious fleet. In addition to the Iwo Jima class LPH, the Tarawa class LHA and the Wasp class LHD (now under construction) provide the amphibious force with considerable helicopter assets. The LHD and LHA ships combine the helo handling capability of the LPH and the well deck features of an LSD. Each Tarawa class ship can carry more than a battalion size force and launch an amphibious assault either by helicopter or landing craft from its well deck. These ships can carry 25 or more helicopters and an impressive mixture of landing craft.²⁰

STATE OF THE ART

The Wasp class LHD is an improved version of the Tarawa class. They will be able to carry about 40 helicopters and assorted landing craft.²¹ Examination of the Wasp class LHD provides us with a look at the current "state of the art" in amphibious warfare. The two most significant technological developments which will affect amphibious ship evolution in the near future are probably the vertical or short take-off and landing light (VSTOL) attack aircraft and the air cushion landing craft (LCAC). While the introduction of VSTOL aircraft has not yet led to development of a ship specifically designed with its employment in mind, this has already occurred in the case of the LCAC. The new Whidbey Island class LSDs, which are now coming on line to replace LSDs built in the fifties, are designed to carry and launch LCACs. The Wasp class LHD with its large well deck will also be able to carry the LCACs of the future.²²

With regard to the US amphibious force of the mid 1980s, United States Marine Corps Commandant, General P. X. Kelley provides the following assessment:

The amphibious assault fleet of today is in its best shape in recent memory, and is going to get better. Six years ago, not a single amphibious ship appeared in the Navy's five year defense program. Today we are well into production of the LSD-41 and LHD-1 classes of amphibious assault ships and have sound programs for the maintenance and upgrading of the amphibious ships currently serving with the fleet. By the mid-1990's, we will have a total of 76 amphibious ships, which will be capable of lifting the assault echelons of both a MAF (Marine Amphibious Force) and a MAB (Marine Amphibious Brigade). The combination of the increase in strategic lift we will realize from both an expanded amphibious fleet and our MPS (Maritime Prepositioning Ships) squadrons will significantly enhance our capability for global response.²³

AMPHIBIOUS SHIPS AND LANDING CRAFT OF THE FUTURE

As we move into the early twenty-first century the helicopter, air cushioned vehicles (ACVs), and VSTOL aircraft will dominate the scene in the amphibious assault arena. Of these, the ACV technology provides the greatest promise for wide scale application to future landing craft. ACVs have been in service in the civilian and military communities for over 20 years. ACV's ability to hover over water, swamps, land, ice and snow make it ideally suited for amphibious warfare. Their hovering capability and ability to achieve high speeds, currently 70 to 80 knots, dictate employment of ACVs mainly as landing and transport vehicles. Their suitability as amphibious landing craft comes from the ability to hover on a layer of compressed air at a height of from .2 to 3 meters without contacting the surface. This unique ability permits the craft movement over waves, as well as travel over shallows, mud flats and

sandbanks, engineering obstacles and mine barriers, river embankments, undergrowth, the remains of walls and other obstacles. The air cushion vehicle is the only truly amphibious vehicle concept in existence today since it does not inherently require special devices to operate over land or water, or any other type of terrain. No special control techniques are required when operating over a variety of surfaces since the craft is inherently stable in all its modes of operation.

The ACVs are equipped with a flexible skirt to trap the large quantity of air which provides its lift. They should not be confused with surface effect ships (SES) which have rigid sidewalls. Although the two types of craft are similar, there are significant differences which affect their applications to military missions. The ACV is better suited for land-water interface, and hence amphibious applications, while the SES with a high length-to-beam ratio is better suited for blue water operation.²⁴

This author sees the potential for both the ACV and SES technology in the amphibious force of the future. The ACV concept is suited for use by transport craft, the role being developed by the LCAC, and also as a troop carrier. The present day LVTs are prime candidates to be replaced by ACVs capable of carrying protected troops ashore at high speeds (in excess of 80 knots) and then move them to inland objective areas at equally impressive speeds. These armed and lightly armored craft will also fulfill the role of a personnel carrier. These new craft, supported by LCAC-like cargo and vehicle transports will allow the Marines to project power ashore deeper and quicker than ever before.

Using developing technology, ACV ships the size of our World War II class LSTs and larger will join the amphibious force. These high speed ships will fulfill the role of our current LSTs. They will carry the ACV troop carriers, modern tanks and support vehicles. Their ability to skim over shoal water, ice, snow, swamps and coral reefs, and transit shallow rivers will provide the amphibious commander with remarkable flexibility. These ships will allow for amphibious assaults in locations previously immune to them.

The SES technology will be used to build large fast amphibious transports and support ships to perform the role of the present day LSD, LKA, LCC and LHA. These ships will be capable of carrying the aircraft (helicopters and VSTOL) and ACV landing craft to the amphibious operation area at tremendous speeds. Once they arrive they will be able to stand well off the coast while the high speed landing craft and personnel craft assault the beach. VSTOL aircraft and high speed ACV type, missile and gunboats will be used to bombard the beach with deadly accurate laser guided weapons during the assault.

Another craft which will be found in support of the amphibious task force of the future will be a strange cross between a ship and airplane. It will be known as the power-augmented wing-in-ground-effect (PAR-WIG) vehicle. This craft will fly close to the surface of the ocean and therefore will have excellent lift characteristics. It will cruise at speeds up to several hundred knots for days and will be capable of carrying payloads far in excess of a conventional aircraft.²⁵ This craft will be used to carry mobilized units and equipment of the United States to the area of operations in a matter of hours or days as opposed to weeks as it takes today.

CONCLUSION

Mark Twain was supposed to have once stated, "The reports of my death have been greatly exaggerated." This statement could well apply to amphibious warfare over the years. Despite repeated claims throughout history that various technological innovations (i.e., gunpowder, mines, machine guns and the atomic bomb) meant the end of amphibious warfare, it is alive and well today. This essay has examined the evolution of amphibious ships and landing craft from Caesar to the "American Caesar" from World War II to the present and into the future. This has been a dynamic process despite long periods in which little change occurred. In the years ahead we can expect changes in this area to occur with much greater rapidity. The employment of amphibious warfare has played a major role in the outcome of wars throughout recorded history, and will continue to do so in the future. The Soviets are well aware of this and working hard to develop their amphibious warfighting capability and are ahead of the US in the development of some amphibious technologies. If the US is to remain the leader in the art of amphibious warfare it must continue to move ahead in the development of new equipment and doctrine for its employment. The amphibious commander of the future will have tremendous assets available to him and now is the time for students at the senior service colleges to begin to explore revolutionary methods to employ these assets at the strategic, operational and technical levels in support of US objectives.

ENDNOTES

1. Arch Whitehouse, Amphibious Operations, 1963, p. vi.
2. Isaac C. Kidd, Jr., "The Surface Fleet," The US Navy, The View from the Mid-1980s, James L. George, ed., 1985, pp. 88-89.
3. Whitehouse, pp. 1-17.
4. Jeter A. Isely and Philip A. Crowl, The US Marines and Amphibious War, 1951, p. 5.
5. Whitehouse, pp. 136-152.
6. Isely and Crowl, p. 19.
7. Ibid., p. 20.
8. Whitehouse, p. 152.
9. Isely and Crowl, p. 69.
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